ABSTRACT

Bird strike is a significant design criterion for leading edges of wing and empennage structures. The certification clauses demand that the aircraft be able to successfully land after the leading edges being struck with a standard bird at cruise velocity of the aircraft for a given altitude. Therefore, the approach followed in the design of leading edges for bird strike is to have a leading edge with improved energy absorption capability which transfers lesser reaction forces to the supporting structures like spars. Since leading edge is the front part of these structures, a careful design to maximise the energy absorption is followed to ensure less damages to supporting structures. In this aspect, a parametric study can help in identifying the parameters which influence the impact behaviour of the leading edges during bird impact. However, parametric evaluation through bird impact testing is highly time consuming and expensive. Hence, parametric evaluation through simulation is attempted as prediction of bird impact behaviour through simulation has become a reality with the availability of modern computers having high computational capability. The ability of ABAQUS/Explicit to effectively handle severely nonlinear behaviour such as contact makes it very attractive choice for the simulation of these high speed events. The major challenges in bird strike simulation are bird modelling, bird - target interface modelling and target failure modelling. The bird model identified was validated with the pressure distribution characteristics obtained from an experimental study defined in the literatures, wherein the bird impact on rigid plates were evaluated. The validated bird model was used to predict the bird impact behaviour of 2 mm plain aluminum leading edge. Python scripting was carried out to automate the repetitive tasks involved in parametric study. In this work, a parametric study is undertaken to understand the role of projectile (bird) parameters and the target parameters (material parameters of skin only) which influences the bird impact characteristics of the leading edges. The parameters studied were analysed for maximum reaction force and the maximum deflection observed during the impact event at particular locations. The cross dependence of parameters on variation of other parameters were also studied. The maximum reaction force and the deformation characteristics observed was directly dependent on the kinetic energy, however it tend to saturate after a certain limit which is basically based on target deformation characteristics which are mainly controlled by the material parameters such as elastic modulus, yield stress, hardening stress and hardening exponent.